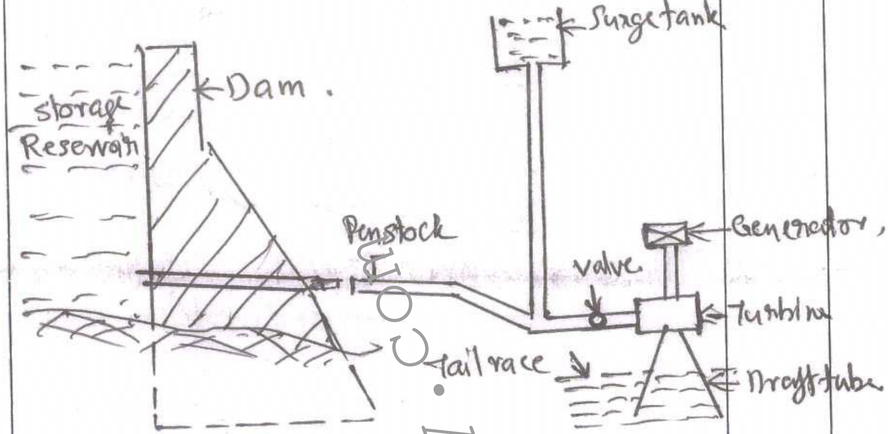
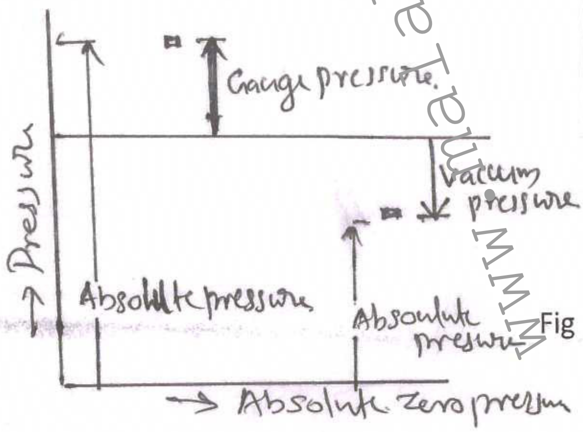
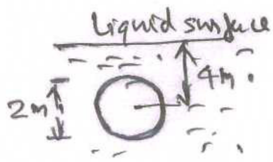
SCORING INDICATOR

REVISION: 2015 **COURSE CODE: 4011**

No	Description	Split score	Sub total	Total
	PART –A			
1).1	**Specific gravity** : Is defined as the ratio of specific weight or density of the liquid to the specific weight or density of pure water at 4 degree centigrade.	2		
2	The quantity of fluid flowing per unit time across any section of a pipe or conduit is called the rate of flow or discharge	2		
3	The section at which maximum contraction of jet is reached is known as vena contracta.	2		
4	The water approaches or reaches the weir or notch has got some velocity. This velocity is known as velocity of approach.	2		
5	The length of base and sides of the channel which comes in direct contact with the liquid stream is called wetted perimeter.	2	10	10
	PART-B (Answer any six question . Each full question carries 6 marks)			
11	1). Sp gravity of oil in pipes, $S_1 = S_3 = 0.80$ Density of oil in the pipes $= \rho_1 = S_1 \times 1000$ $= 0.80 \times 1000 = 800\ kg/m^3$	1		
	Difference of mercury level $h_2 = 100\ mm = 0.10 m$ Specific gravity of mercury, $S_2 = 13.6$ Density of mercury $\rho_2 = S_2 \times 1000$ $= 13.60 \times 1000 = 13600\ kg/m^3$	2		
	Using the equation for difference of pressures of oil in the pipe at the same level $P_A - P_B = (\rho_2 - \rho_1) g\, h_2$ $= (13600-800) \times 9.81 \times 0.10 = 12.556\ KN/m^3$	3	6	
	2).1.Steady and unsteady flow 2.Uniform and non uniform flow 3.Laminar and turbulent flow 4.Compressible and incompressible flow 5.Rotational and irrotational flow 6.One , two and three dimensional flow	(6 x1)	6	

	3).Following are the hydraulic coefficients (i). coefficient of contraction Cc (ii). coefficient of velocity Cv (iii) coefficient of discharge Cd	1.50		
	coefficient of contraction Cc : The contraction of jet at vena contracta is defined by a coefficient known as coefficient of contraction. It is the ratio of the jet at vena contracta to the area of the orifice denoted by Cc $Cc = a_c / a$ Cc varies from 0.61 to 0.69	1.50		
	coefficient of velocity Cv : It is the ratio of actual velocity of jet at vena contacta to the theoretical velocity of jet usually denoted by C_v C_v varies from 0.95 to 0.99	1.50		
	coefficient of discharge Cd : It is the ratio of actual discharge from an orifice to the theoretical discharge from the orifice is known as coefficient of discharge. It is denoted by Cd The value of Cd varies from 0.60 to 0.64	1.50	6	
	4). Actual discharge Q= 98.20 Lr/s = 0.0982 m^3/s Dia of orifice 'd' = 120 mm = 0.12m Head H = 10 m Hor. Distance of a point on the jet from vena contracta x = 4.50 m Vert. distance y= 0.54m C/s area of orifice $a = (\pi/4)\, d^2$ $= (\pi/4) \times (0.12)^2 = 0.01131\ m^2$	1		
	$Qth = a\sqrt{2gh} = 0.01131 \times \sqrt{2 \times 9.81 \times 10}$ $= 0.1584\ m^3/s$	2		
	$Cd = Q/Qth = (0.0982/0.1584) = 0.62$	1		
	$Cv = x/(\sqrt{4yH}) = 4.5/(\sqrt{4 \times 0.54 \times 10}) = 0.96$	1		
	$Cc = Cd/Cv = 0.62/0.96 = 0.64$	1	6	
	5).1.In a right angled V notch the expression for the computation of discharge is very simple to remember ($Q = 1.417\ H^{5/2}$) 2.For measuring more accurate results for low discharge, triangular notch is preferred than rectangular notch 3.In case of triangular notch, only one reading i.e head H is required to be taken for the computation of discharge			

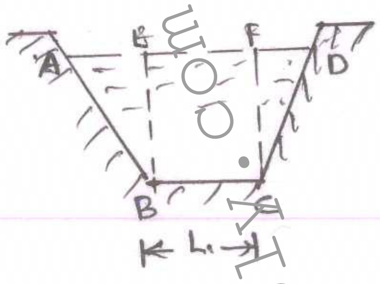
	4.No need for ventilation of triangular notch 5.The same triangular notch can measure a wide range of flows accurately 6. The head over the crest of triangular notch is independent of wetted edge	(6 x1)	6	
	6).  Lay out	4		
	(i).Storage reservoir (ii) Dam (iii), Water ways and Penstock (iv). Surge tank (v) Power house with Turbine (vi) Tail race	2	6	
	7). Length of pipe l =2000m Discharge Q = 200 lr/s =0.20m³/s Head loss due to friction h_f = 4 m Friction factor f = 0.006 Using Darcy`s formula $h_f = fl\,Q^2/3d^5$ Diameter of pipe , $d = \sqrt[5]{(fl\,Q^2/3\,h_f)}$	2		
	$= \sqrt[5]{((0.006 \times 2000 \times 0.2^2)/(3 \times 4))}$	3		
	d = 0.525 m or 525 mm	1	6	(any 5x6=30)

	PART-C (Answer any one full question from each unit, each question carries 15 marks) UNIT-1			
111.	a). **Atmospheric pressure** : Atmospheric pressure exerted by the envelop of air on the earth surface or by the weight of air exerted on the earth surface. Atmospheric pressure decreses with increasing altitude at a decreasing rate.	2		
	Gauge pressure: Is defined as the pressure which is measured with the help of a pressure measuring device, in which atmospheric pressure as datum. The atmospheric pressure on the scale is marked as zero.	2		
	Absolute pressure : It is the pressure equal to the algebraic sum of atmospheric and gauge pressure. It is defined as the pressure which is measured with reference to the absolute vaccum pressure	2		
	 Fig	1	7	
	 b). Diameter of plate d= 2m Area of plate a=(π/4) d^2 =(π/4)/2^2 =3.1416 m^2 Depth of CG of the area from liquid surface	1		

	h = 4 m Total pressure P = ρgah $= 1000 \times 9.81 \times 3.1416 \times 4$ $= 123276.38\ N/m^2$ **= 123.28 KN/ m²**	2		
	MI of circular plate about its horizontal centroidal axis $I_G = (\pi d^4)/64$ $= \pi \times 2^4/64 = 0.7854\ m^4$	2		
	Position of centre of pressure from free water surface, $C = (I_G/ah)/h = ((0.7854)/(3.1416 \times 4)) + 4 =$ **4.06 m**	3	8	15
	OR			
IV	a) Bernoulli`s theorem states that in a steady continuos flow of friction less incompressible fluid, the sum of potential head, pressure head and kinetic head is the same at all points. It is mathematically represented as $(p/\rho g)+(v^2/2g)+z = \text{constant}$	2		
	Assumptions : (i). Fluid is ideal (viscocity is zero) (ii). Flow is steady (iii). Flow is incompressible (iv). Flow is irrotational (v) . Flow is one dimensional	5	7	
	b). Dia. of inlet pipe, $d_1 = 50mm = 0.05\ m$ Dia. at throat , $d_2 = 20\ mm = 0.02\ m$ Venturi head $h = 420\ mm = 0.42\ m$ $C_d = 0.97$ Area at inlet , $a_1 = (\pi/4) \times (0.05^2) = 0.001963\ m^2$	2		
	Area ratio $K = (a_1/a_2) = (d_1/d_2) = (0.05^2/0.02^2)$ $= 6.25$	2		
	Rate of flow $Q = C_d \times [(a_1 . a_2)/(\sqrt{a_1^2 - a_2^2})] \times \sqrt{2gh}$ $= [(C_d \times a_1)/\sqrt{k^2-1}] \times \sqrt{2gh}$ $Q = [0.97 \times 0.001963 \times (\sqrt{2 \times 9.81 \times 0.42})]/[\sqrt{6.25^2-1}]$ = <u>0.88597 lr/s or 53.1582 lr /minute</u>	4	8	15
	UNIT-11			
V	a). Width of orifice , b = 1.0 m Depth of orifice , d = 0.30m Height of liquid above top of orifice, $H_1 = 0.25\ m$			

	Height of liquid above bottom edge , H2 = 0.55 m Coefficient of discharge Cd = 0.62 Q=[(2/3)cd x bx $\sqrt{(2. g)}$x [H2^(3/2)-H1^(3/2)] = <u>0.5179 m^3/s</u>	3		
	If the orifice is treated as small one, Q = Cd x a x$\sqrt{(2.g H)}$ a = b x d = 1 x0.30 = 0.30 m^2 H = H1 + (d/2) = 0.25+(0.30/2) =0.40m Q= 0.62 x 0.30x $\sqrt{(2 x9.81x 0.40)}$ =0.521 m^3/s	4	7	
	b). **Impulse turbine** : In an impulse turbine , the potential energy possessed by the water is first converted in to kinetic energy by expanding it through a nozzle or guide vanes. As water flows over the vanes , the pressure of water is atmospheric from inlet to out let of the turbine, hence the wheel revolves in open air. The jet of water discharged from the nozzle strikes on the series of suitably shaped blades or buckets fixed around the rim of a wheel. The velocity and direction of the water undergo changes as it flows over the buckets and the wheel rotates due to the impulse of the water. The water flows under atmospheric pressure and the wheel, therefore, does not require to run full. So the turbine wheel must be placed above the tail race. The water may be admitted over a part of circumference or over the whole circumference.the resulting change in momentum sets buckets and the wheels in to rotary motion and thus these turbines convert kinetic energy in to mechanical energy and is made available at the turbine shaft. Draft tubes are not usually used with impulse turbines. A pelton wheel is a type of impulse turbine.	8	8	15
VI	**OR** a).1. Cost of centrifugal pump is less as it has fewer parts 2.Installation and maintenance is easier and cheaper 3.Discharge capacity is much higher than that of reciprocating pump. 4. Gives smooth and continuos flow 5. Run at higher speed without any possibility of cavitation 6.Compact and less weight for the same capacity			

	and energy transfer 7.Used for pumping viscous fluids 8.Directly and easily coupled to an electric motor 9. Performance characteristics are superior	any 7 x1	7	
	b).(i) **running full :** $Q = Cd. a. \sqrt{(2.g.H)}$ H= 9 m Area , a = π x(0.60^2)/4 = 0.2827 m^2 Cd for running full =0.707 Q= 0.707 x 0.2827 x $\sqrt{(2 \times 9.81 \times 9)}$ = 26.57 lr/s	 1 1 2		
	(ii) **Running free :** For running free Cd = 0.50 $Q = Cd. a. \sqrt{(2.g.H)}$ = 0.50x 0.2827 x$\sqrt{(2 \times 9.81 \times 9)}$ = 18.80 Lr/s	 1 1 2	8	15
VII	**UNIT-111** a).(i) **Storage reservoir :** reservoir is used to store the water available from a catchment area. From the reservoir water is taken to the turbine , through the penstock, to produce the electric power.	2		
	(ii).**Penstock :** It is a pipe used to carry the water from reservoir to the turbine house. It should be laid in such away that following the shortest route.While laying down the penstock it should be noted that , it should not rise above the hydraulic gradient at any point. Penstock are made either of welded or riveted steel plates or reinforced cement concrete.	3		
	(iii). **Surge tank :** It is located on the penstock near the power house for the purpose of speed and pressure regulation. It protect the penstock against water hammer. These are very necessary when the length of the penstock is more	2	7	
	b) Length of rectangular notch L= 1 m Head over rect. Notch H1 =0.15m Cd1 (rect. Notch) = 0.62 Cd2 (tri. Notch) = 0.59 Head over tri. Notch = H2 Discharge for Rect. Notch Q= (2/3)[Cd1x Lx $\sqrt{(2xg)}$. H1^3/2]	 2		

	$Q = (8/15)\ C_{d2}\sqrt{(2 \times g)}.\ H_2^{5/2}$ The same discharge occurs over the rectangular notch as that over the triangular notch. There for $Q_1 = Q_2$	2		
	$(2/3)\ C_{d1}\ L\ \sqrt{(2 \times g)}.\ H_1^{3/2} = (8/15)\ C_{d2}\sqrt{(2 \times g)}.\ H_2^{5/2}$	2		
	Cancelling $\sqrt{(2 \times g)}$ on both sides, $(2/3) \times 0.62 \times 1 \times (0.15)^{3/2} = (8/15) \times 0.59 \times H_2^{5/2}$ Solving the above expression **<u>$H_2 = 0.357$ m</u>**	2	8	15
VIII	**<u>OR</u>** a).  Fig	2		
	Let H is the height or head of water over the notch L is the length of the rectangular portion C_{d1} – co efficient of discharge for rect. Portion C_{d2}- co efficient of discharge for triang.portion (θ /2) – Is the angle, which the sides makes with the vertical For rectangular portion BCFE is given by $Q_1 = (2/3)\ C_{d1}.\ L.\ \sqrt{(2.g)}.H^{3/2}$	1		
	Discharge through the two triangular portion ABE and DCF is equal to the discharge through a single triangular portion of an angle θ is given by $Q_2 = (8/15).\ C_{d2}.\ \sqrt{(2.g)}.\ \tan(\theta/2).\ H^{5/2}$	2		
	Total discharge $Q = Q_1 + Q_2$ $Q = [(2/3)\ C_{d1}.\ L.\ \sqrt{(2.g)}.H^{3/2}] + [(8/15).\ C_{d2}.\ \sqrt{(2.g)}.\ \tan(\theta/2).\ H^{5/2}]$	2	7	
	b).Length of weir L= 6 m Head above crest H= 0.70m Cd= 0.60 C/s area A= 5 m^2 Discharge $Q = 1.705.\ C_d.\ L.\ H^{3/2}$ $= 1.705 \times 0.60 \times 6 \times 0.70^{3/2}$ = **3.5947 m^3/s**	2		

	Velocity approach is given by $V_a = 3.5947/5 = 0.7189$ m/s Velocity head $h_a = V_a^2/2.g = 0.7189^2/(2\times 9.81)$ $= 0.0263$ m of water Total head over the weir $H1 = H + h_a = 0.70 + 0.0263$ $= 0.7263$ m Considering velocity of approach Q = 1.705. Cd. L.[H ^3/2 - ha^3/2] = 1.705x 0.60x 6x .[0.7263 ^3/2 - 0.0263^3/2] = **3.773 m^3/s**	2 1 3	8	15
IX	**UNIT-1V** a). **Major or primary losses :** This loss is due to the friction and is called loss of Head due to friction **Minor or secondary losses :** This losses are due to some other reasons other than friction. They are (i). losses due to sudden enlargement of pipe c/s (ii). Losses due to sudden contraction of pipe c/s (iii). Losses due to bend in pipe (iv).Losses due to pipe fittings (v) Losses due to an obstruction in pipe (vi) Loss of head at inlet or entry to a pipe (viii)Loss of head at exit or outlet (any 6x1)	1 6	7	
	b). width of channel , b = 6m slope of channel , i = 1 in 1000 = 1/1000 depth of water , d = 4m Chezy`s constant C= 60 Area of flow , A = b.d = 6x4 = 24 $m^2$ Wetted perimeter, P = b+2d = 6+(2x 4)= 14 m Hydr. Mean depth , m= A/P = 24/14 = 1.7143m According to chezy`s equation , $V = C\sqrt{mi}$ $= 60 \times \sqrt{(1.7143 \times 0.001)}$ = <u>2.4842 m/s</u> Discharge Q = AxV = 24 x 2.4842 =**59.6208m^3/s**	1 1 1 2 3	8	15
X	**OR** a). **Water hammer :** Water flowing through a long pipe line is brought to rest by suddenly closing the valve provided on the pipe line. The closure of valve , there will be a sudden rise in pressure due to the momentum of water being destroyed. A pressure wave is transmitted along the pipe due to closing the			

	valve create noise in the pipe known as knocking. The sudden rise in pressure has the effect of hammering action on the walls of the pipe and hence this phenomenon is known as water hammer. The magnitude of pressure rise depends on	5		
	1. Speed at which valve is closed 2. The velocity of flow of water in pipe 3. The length of pipe 4. The elastic properties of the material of pipe as well as that of fluid	2	7	
	b). diameter of pipe , d = 0.20 m length of pipe , l = 60 m velocity of flow V= 2.50 m/s Darcy`s constant f = 0.005 Chezy`s constant C = 55			
	<u>Using Darcy`s formula</u>	1		
	Head loss , $h_f = (4flv^2/2gd)$ $= (4 \times 0.005 \times 60 \times 2.50^2)/(2 \times 9.81 \times 0.20)$ = **1.911 m of water**	2		
	<u>Using chezy`s formula</u> Hydr.mean depth , m = d/4 = 0.20/4 = 0.05 m	1		
	Loss of head per unit length , $i = h_f/l = h_f/60$	1		
	Using chezy`s formula , $V = C\sqrt{(mi)}$	1		
	Substituting $2.50 = 55 \times \sqrt{(0.05 \times h_f/60)}$ Solving h_f = **2.479 m of water**	2	8	15
	....			